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(54) METHOD AND APPARATUS FOR DIVIDING AND BEAD SEALING PLASTIC SHEETS, AND FOR MANUFACTURING PLASTICS BAGS

(71) I, DAVID ALBERT DAISLEY of Wellington, Burtons Way, Little Chalfont, Buckinghamshire, a British Subject, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method and apparatus for dividing, and bead sealing (also known as side welding) the resultant edges of, two overlying plastics sheets, and for manufacturing plastics bags.

Many methods and apparatus are already known for this purpose. A plastics material such as polythene presents few difficulties. However, polyester materials, nylon, cast polypropylene and other biaxially orientated films are more difficult. Such materials are more 'brittle', and bead sealing of edges is only partially successful unless carefully carried out. In particular, a bead seal of a single sheet of polyester film folded back on itself is particularly weak in the very corner adjacent the fold. The seal is particularly easily burst by internal pressure, in, for example, a plastics bag.

As a result, it has been common practice to manufacture plastics bags using hot knife and impulse sealing systems from two overlying films by making welds on three sides, often incidentally generating strip waste material in the process.

The invention aims to provide a method and apparatus for dividing, and bead sealing the resultant edges of, plastics sheets, for example for manufacturing plastics bags, in particular of polyester film, in which the bead welds are satisfactory and there is little or no waste.

The invention provides a method of dividing, a bead sealing the resultant edges of, two overlying plastics sheets, in which said sheets pass continuously in an arc around a support which has a circumferential groove and is cooled by a flow of gas and/or water; heating an elongate cutter member in the form of a metal tape or wire which extends substantially tangentially of said arc and enters said groove; and reciprocating said member in the direction of its own length to divide and bead seal the sheets.

The invention also provides a method of manufacturing plastics bags from two continuous overlying plastics sheets, which includes the steps of dividing the sheets longitudinally and joining the resultant edges of the two sheets by the method as just mentioned to form the bottoms of the bags along the division, and dividing the sheets transversely and joining the resultant edges of the two sheets to form the sides of the bags along the transverse division, two bags being formed across the width of the sheets.

In order to carry out the firstmentioned method according to the invention, the invention also proposes apparatus for dividing, and bead sealing the resultant edges of, two overlying plastics sheets, comprising a feed path; means for causing the sheets to continuously pass along the feed path, said path extending in an arc around a support which has a circumferential groove; means for cooling the support; an elongate cutting and sealing member in the form of a metal tape or wire which extends substantially tangentially of said arc and enters said groove; means for heating said cutting and sealing member; and means for reciprocating said member in the direction of its own length.

In a further development, the invention includes apparatus for manufacturing plastics bags comprising a first apparatus for longitudinally dividing, and bead sealing the resultant edges of, the two sheets as just described, a second apparatus for transversely dividing, and bead sealing the resultant edges of, the two sheets, thus forming two plastic bags across the width of the sheets, the bottom seal of each bag being made by the first apparatus and the two side seals of each bag being made by the second apparatus.

A number of possible arrangements will be proposed for effecting the transverse cutting and sealing, which may be carried out with the films moving or stationary.

The invention will now be more fully described with reference to a practical embodiment, which is illustrated in the accompanying drawings.

In these drawings:

Figure 1 shows an overall schematic view of an apparatus for making plastics bags;

Figures 2 and 3 show details of the means for effecting longitudinal division and bead sealing of the films, in accordance with the invention;

Figures 4 and 5 show details of a first means for effecting transverse division and bead sealing of the films;

Figures 6, 7 and 8 show details of a second means for transverse division and bead sealing;

Figure 9 shows schematically the operation of a third means for transverse division; and

Figures 10*A*, 10*B* and 10*C*, Figures 11*A* and 11*B*, and Figure 12, all illustrate further means for transverse division.

Turning now to Figure 1, this shows an overall side view of an apparatus for producing plastics bags, starting from two, continuously fed polyester films. The films are provided on rolls 10, 11 and are immediately brought together and fed as one through a set of tensioned dance rollers 12. These ensure that the tension in the film stock 13 remains constant and that variations in the feed or roll tension do not affect the manufacturing process.

The film stock has a width twice the intended depth of the base to be produced.

The overlying films are passed together to a relatively large diameter roller 14, being constrained to remain in contact with the roller over approximately 250° by two further smaller rollers 15. while passing over the roller 14, the film stock is divided longitudinally and at the same time bead sealed along both sides of the division. This process will be further described with reference to Figures 2 and 3.

From the roller 14, the film stock, now in two longitudinal parts, passes between capstan rollers 16, static eliminators 17, to means 18 for dividing the stock transversely and simultaneously bead sealing both cut edges. In this manner, plastics bags are produced which are open at one end (at the edges nearest and furthest from a person looking at Figure 1), are sealed at the bottom (along the middle division of the original film stock), and which have two side seams (lying transversely of the original film stock). The bags issue two at a time from the dividing and sealing means 18, and are received by a belt conveyor arrangement 19. The latter is arranged to operate at a higher speed than the feed of the film stock, and its upper moving belt 21 is pivotable and is arranged so as to grip the two bags emerging from the means 18 and to accelerate them away.

Figure 2 shows an end view of the roller 14, to a larger scale, and Figure 3 shows a part sectional view on the line III-III of Figure 2. The roller 14 is hollow and is cooled with a water and/or air supply, and has a circumferential groove 22 mid-way along its length. At the top of the roller there is accommodated a hot cutter 23. The cutter is mounted in a frame 24 reminiscent of a hacksaw, and is provided with tensioning means 25, e.g. springs, or hydraulic or pneumatic piston and cylinder assembly, which allows for expansion of the cutter 23 when heated. An initial tensioning screw 26 is also provided. The whole hot cutter arrangement is mounted for reciprocation relative to the roller 14 in the direction of the arrows 27. This eliminates uneven wear on the hot cutter. The cutter 23 is in the form of a nickel chrome wire or tape .010 inches thick by .060 inches deep. It is heated electrically to medium red heat and controlled by a rheostat.

At the same time as the overlying films 13, (Figure 3) are divided by the hot wire 23, they are simultaneously bead sealed along the cut edges 28.

The now separate double strips pass to the transverse dividing and sealing means 18. This is described in greater detail in Figures 4 and 5. Figure 5 shows an end view of the means 18 similar to Figure 1, but to a larger scale, Figure 4 shows a section on the line IV-IV in Figure 5. The means 18 comprises two rollers 30, 31. The roller 30 has a longitudinal slot 32 in its surface, which co-operates, in operation, with a longitudinal heated nickel chrome tape or wire 33 mounted in a slot 34 in the roller 31.

The slot 34 is filled with a heat-resistant ceramic material 35, and the tape or wire 33 is mounted by means of a tensioning arrangement similar to that described in Figure 2.

The radii of the two rollers 30, 31 are equal and are so chosen that their circumference is equal to the intended width of the bags to be produced. Both rollers may be air and/or water cooled.

In operation, the plastics film stock passes through the static eliminator 17 and between the rotating rollers 30, 31. When the heated tape or wire 33 reaches the plane of movement of the stock 13, it passes through this plane cutting the stock transversely and enters the slot 32. Thus, the stock is again cut and bead sealed simultaneously. Seals are made at both sides of the tape or wire, thus performing a third seal to complete two bags lying to the left of the line IV-IV, and performing a second seal of uncompleted bags lying to the right of the line IV-IV.

In practice, it may be necessary to rotate the two rollers 30, 31 at a speed greater than the speed of movement of the stock 13 in order to ensure that the heated tape or wire 33 does not

remain in contact with the edge of the stock after it has been severed. In that case, the rollers 30, 31 would need to be of larger diameter.

The need to remove the cut edges of the polyester films from the heated tape or wire is also the reason for arranging that a conveyor arrangement 19 should "snatch" the completed bags away from the rollers.

Figures 6, 7 and 8 illustrate a second means for transverse division. The longitudinal slitting of the polyester film stock is carried out precisely as described with reference to Figures 1, 2 and 3. After leaving that part of the apparatus, the stock is passed in this case through a further set of dance rollers and feed rollers before reaching the transverse cutting and sealing arrangement 41. The latter is illustrated in Figures 6 and 7 and is arranged to operate only when the film stock is stationary. A stationary support 42 is hollow and cooled, and has a groove 43 running along its length. This support lies transversely of the direction of movement of the stock. Above the support are wedge shaped clamping members 44, which are movable vertically to arrest or release the stock as it passes over the support. Also above the latter and between the clamping members 44 is a cutter device 45 having a heated tape 46. In operation, the stock 13 passes over the support 42 until a sufficient length to form the next two bags has passed. The stock is then clamped by members 44, the further feed rollers are stopped, and the cutting device 45 is then rapidly lowered and raised again. The stock still being fed by the capstan rollers 16 is accommodated by the further set of dance rollers. Once the clamping members 44 rise again, the completed bags are "snatched" by the conveyor arrangement 19, and the drive of the film stock is resumed by the further feed rollers.

In an improved form of the cutting and sealing arrangement 41 shown in Figure 8, the clamping members 144 and the cutter device 145 are formed with a hollow cross-section which is water or gas cooled in the same way as the stationary support 142, the water itself being chilled if necessary.

This is of importance in a machine which is running at high speed, since it must be possible to handle the weld immediately after it has been made. Without cooling, the weld might remain soft for a relatively lengthy period of time in relation to the speed of movement of the film and bags. Water cooling of this kind is applicable to a number of the embodiments described.

This applies whether the heated tape 146 is supported in a bed of ceramic or ceramic composition material 147, or is simply freely suspended between end tensioning means. In order to produce the best possible cut and weld, it should be ensured that the edges of the slot 143 in the support 142 and the edges of the jaws of the clamping members 144 are sharp, and are accurately aligned.

Figure 9 illustrates an arrangement very similar to that shown in Figures 6 and 7 or 8, but in this case, the feed of the film stock is not stopped, and the whole cutting and sealing means moves with the stock from right to left in the drawing. After cutting and sealing the cut edges, the means is transported back to its starting position at the right hand side. This arrangement avoids the need for the extra set of dance rollers, but involves complications inherent in reciprocating the whole of the cutting and sealing means.

In the arrangement shown in Figure 10, the film stock is caused to be deflected through an angle 90°. A hollow drum 50 lying transversely of the direction of motion of the film stock is arranged to turn anti-clockwise through an angle of approximately 70° and then to return to its original position. The drum 50 has a slot 51 which receives a heated cutting wire or blade 52 along its length. The latter is mounted in a head 53 which can move radially of the drum 50. In addition the head 53 is mounted within a housing 54 which moves angularly with the drum.

In operation, the film stock passes around the drum 50 and is maintained in contact therewith by static electricity. When a sufficient length of the stock has passed over its surface, rotation of the drum is commenced. The starting position is shown in Figure 10*A*. After a movement of about 5°, to the position shown in Figure 10*B*, the cutting head 53 is moved radially inwards so that the blade 52 enters the slot 51. The blade severs the film stock and bead seals the edges to either side of it. As the drum 50 is rotated, the head 53 is withdrawn radially outwards, and when the position shown in Figure 10*C* is reached, the drum and associated cutting head is ready to return to its starting position. The formed bags are removed from the drum in a downward direction by suitable conveyor means. The return movement of the drum clockwise is counter to the direction of feed of the film stock.

Another apparatus for cutting and sealing transversely is shown in Figures 11*A* and 11*B*. In this case, a short heated wire device 55 is mounted for movement along a rail 56 which lies diagonally across the direction of movement 57 of the film stock. The device 55 is movable vertically as shown in Figure 11*B*, and its heated wire or tape can co-operate with a helical slot 59 cut in a rotatable roller 58 lying directly beneath the rail 56. The film stock passes between the roller 58 and the device 55. In use, the device 55 moves from top to bottom of Figure 11*A*, with the heated wire engaged in the helical slot 59. The device 55 then rises and flies back to the starting end of the rail 56 before lowering again to effect another cut. The roller 58 is rotated to maintain the heated wire

in the slot.

Figure 12 shows a yet further transverse cutting and sealing arrangement, in which a heated pin 61 traverses the moving film stock diagonally while engaged in a fixed channel 62.

It will be seen from the foregoing that a great variety of arrangements are available for cutting the film stock transversely. The arrangements shown and the method described provide very satisfactory plastics bags under the most economical conditions.

In general, it should be noted that all parts in the vicinity of the heated wires or tapes, in particular all clamps, rollers and supports, preferably should be air and/or water cooled, as has been specifically described for some embodiments.

WHAT I CLAIM IS:—

1. A method of dividing, and bead sealing the resultant edges of, two overlying plastics sheets, in which said sheets pass continuously in an arc around a support which has a circumferential groove and is cooled by a flow of gas and/or water; heating an elongate cutter member in the form of a metal tape or wire which extends substantially tangentially of said arc and enters said groove; and reciprocating said member in the direction of its own length to divide and bead seal the sheets.

2. A method as claimed in Claim 1 wherein the support is a cylindrical roller which is rotated.

3. A method as claimed in Claim 1 or 2, wherein the cutter member is heated to medium red heat.

4. A method of manufacturing plastics bags from two continuous overlying plastics sheets, which includes the steps of dividing the sheets longitudinally and joining the resultant edges of the two sheets by the method of any of Claims 1 to 3, to form the bottoms of the bags along the division, and dividing the sheets transversely and joining the resultant edges of the two sheets to form the sides of the bags along the transverse division, two bags being formed across the width of the sheets.

5. A method as claimed in Claim 4, wherein the longitudinal division is effected prior to the transverse division.

6. A method as claimed in Claim 4 or 5 wherein transverse division is effected while the sheets continue moving.

7. A method as claimed in Claim 4 or 5 wherein transverse division is effected with the sheets tationary at the point at which division takes place.

8. A method as claimed in Claim 6 or 7 wherein the sheets are clamped together on either side of the transverse division line during the transverse division.

9. An apparatus for dividing, and bead sealing the resultant edges of, two overlying plastics sheets, comprising a feed path; means for causing the sheets to pass continuously along the feed path, said path extending in an arc around a support which has a circumferential groove; means for cooling the support; an elongate cutting and sealing member in the form of a metal tape or wire which extends substantially tangentially of said arc and enters said groove; means for heating said cutting and sealing member; and means for reciprocating said member in the direction of its own length.

10. Apparatus as claimed in Claim 9 wherein said support is a cylindrical roller.

11. Apparatus as claimed in Claim 9 or 10 wherein the cutting and sealing member is held in a frame.

12. Apparatus for manufacturing plastics bags comprising a first apparatus for longitudinally dividing, and bead sealing the resultant edges of, the two sheets as claimed in any of Claims 9 to 11, a second apparatus for transversely dividing, and bead sealing the resultant edges of, the two sheets, thus forming two plastics bags across the width of the sheets, the bottom seal of each bag being made by the first apparatus and the two side seals of each bag being made by the second apparatus.

13. Apparatus as claimed in Claim 12 wherein the second apparatus comprises a transverse heated cutting and sealing member with a straight cutting edge transverse to the direction of movement of the sheets.

14. Apparatus as claimed in Claim 12 wherein the transverse cutting and sealing member comprises a metal tape or wire held under tension and set in a bed of heat resistant material.

15. Apparatus as claimed in Claim 13 or 14 wherein the transverse cutting and sealing member is mounted for movement towards and away from the path of the sheets at the transverse cutting and sealing station, and enters a channel in a counter plate on the opposite side of the path.

16. Apparatus as claimed in Claim 15 wherein both the transverse cutting and sealing member and the counter plate are fixed in the direction of movement of the sheets at the transverse cutting and sealing station and means are provided for stopping movement of the sheets at that station while the second device operates.

17. Apparatus as claimed in Claim 15 wherein both the transverse cutter member and the counter plate are arranged to be movable in the direction of movement of the sheets at the transverse cutting station, and at the same speed as the sheets.

18. Apparatus as claimed in Claim 13 or 14 wherein the transverse cutting and sealing member is straight and mounted along the outer surface of one of a pair of rollers, the other forming a counter surface and having a corresponding straight groove therein, the path of the sheets extending between the pair of rollers and the radii of the rollers being equal so that once in each revolution the cutting and sealing member enters the groove.

19. A method of manufacturing plastics bags substantially as described herein with reference to the accompanying drawings.

20. Apparatus for manufacturing plastics bags substantially as described herein with reference to the accompanying drawings.

21. A method of dividing, and bead sealing the resultant edges of, two overlying plastics sheets, substantially as described herein with reference to the accompanying drawings.

22. A device for dividing, and bead sealing the resultant edges of, two overlying plastics sheets, substantially as described herein with reference to the accompanying drawings.

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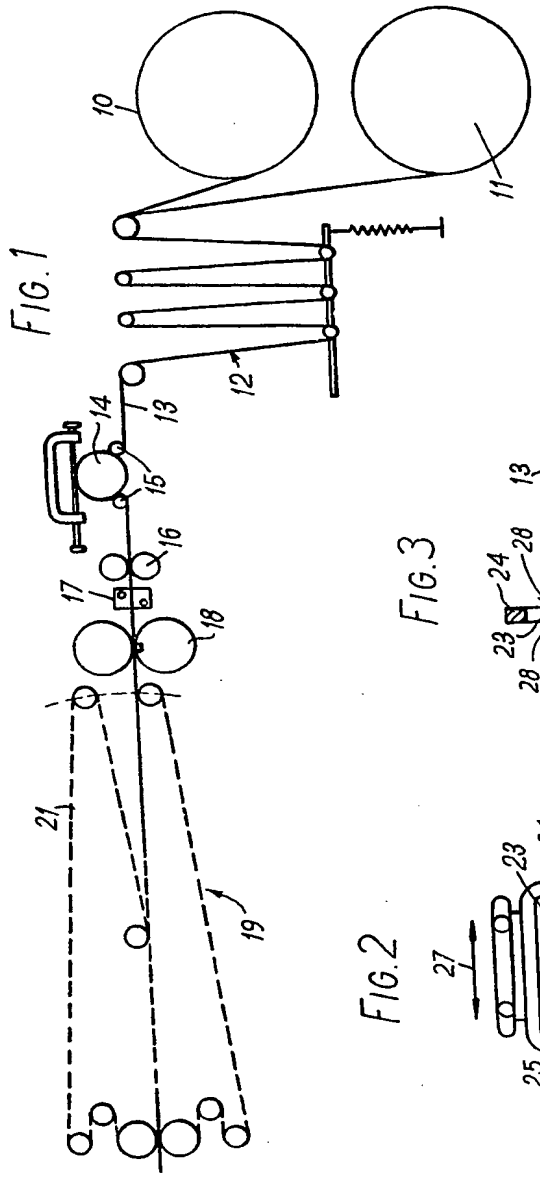

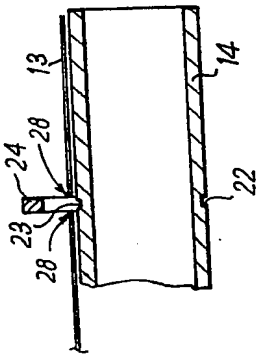

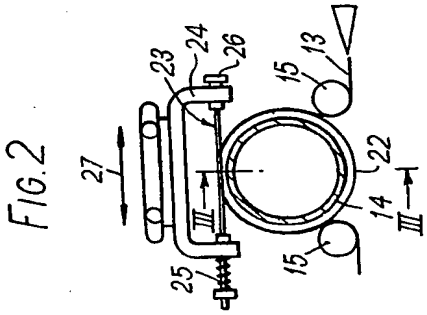

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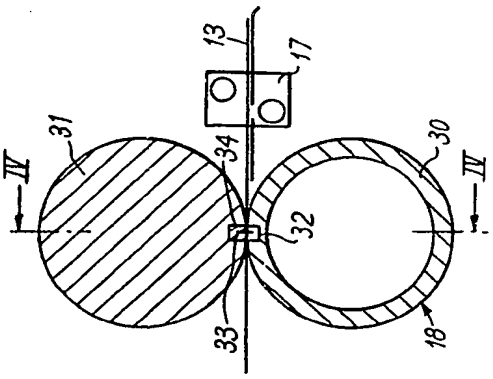

FIG.5

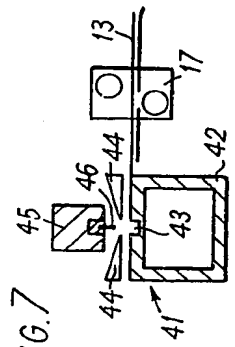

FIG.7

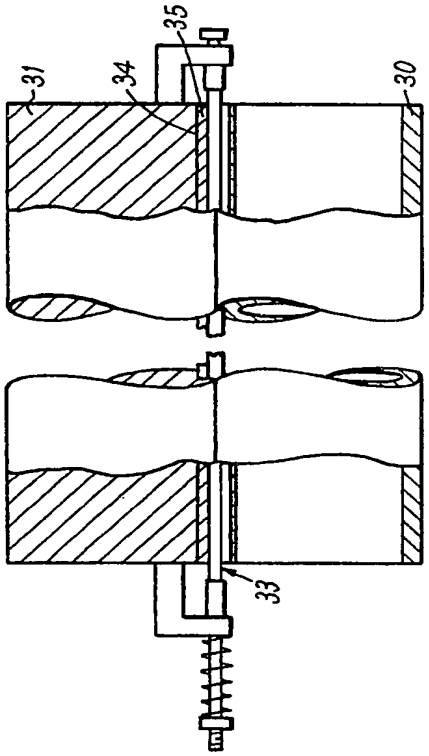

FIG.4

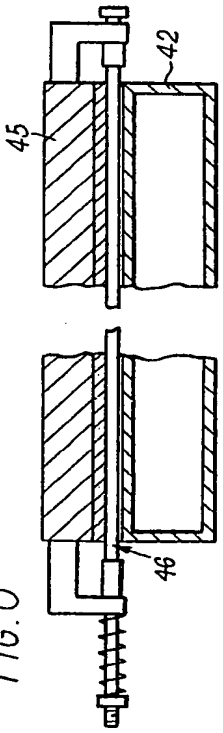

FIG.6

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FIG.8

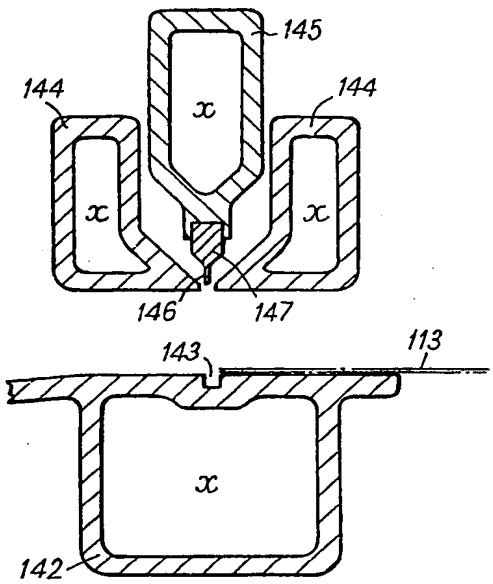


FIG.11a

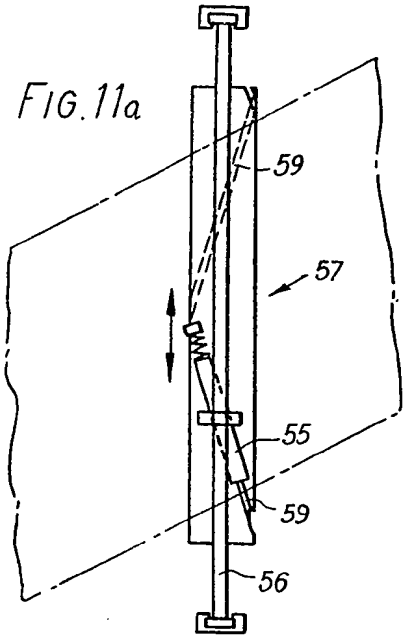


FIG.11b

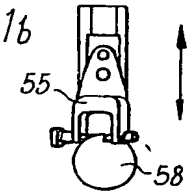
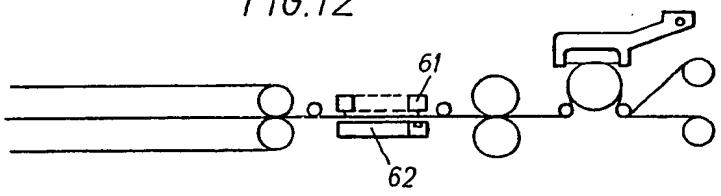


FIG.12



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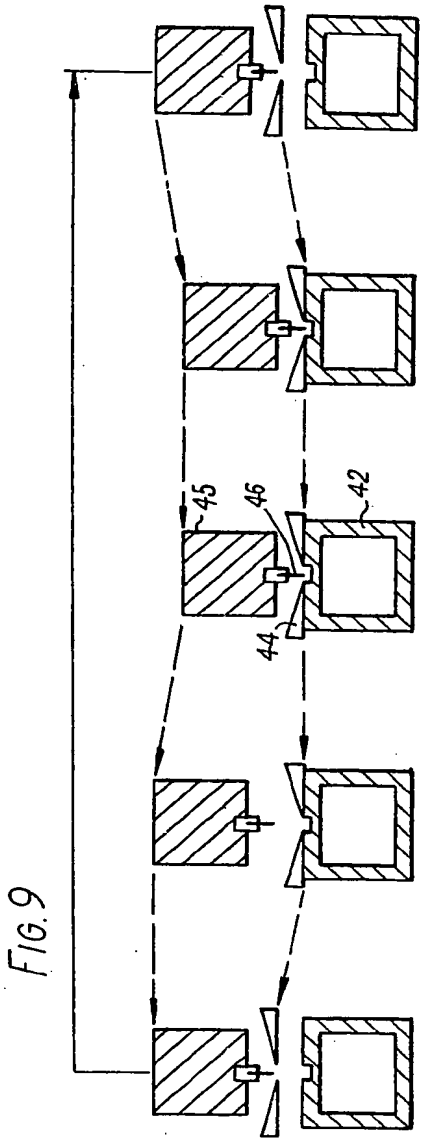

FIG. 9

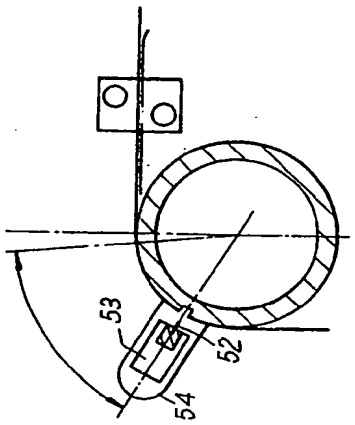

FIG. 10c.

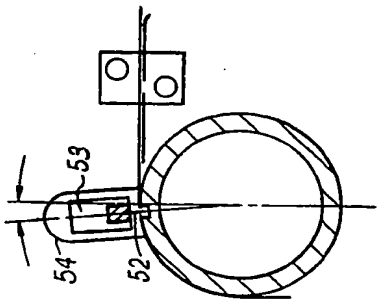

FIG. 10b.

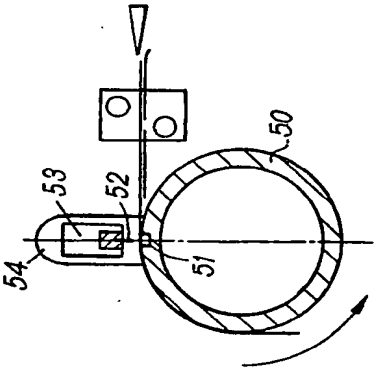

FIG. 10a.